Coleman Research Corporation

Geophysical Data Fusion for Subsurface Imaging

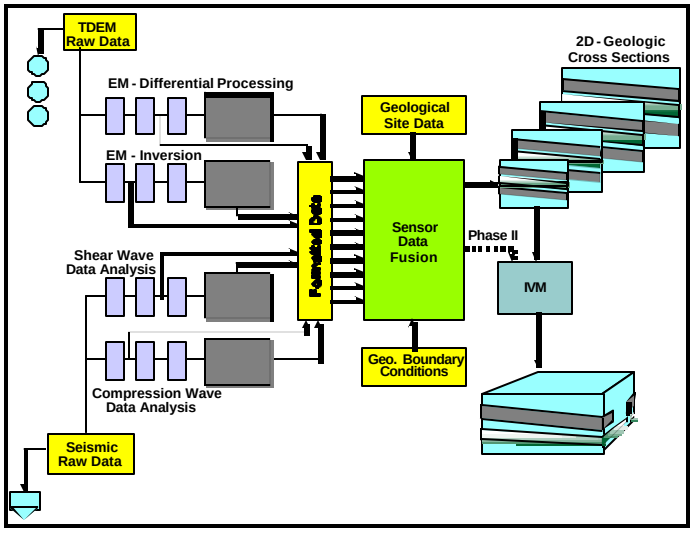
Technology Need:

No software package existed for use in a workstation for geophysical data fusion for subsurface imaging. Measuring and imaging several hundred feet of depth of highly stratified geologies with thin (less than three feet thickness) and discontinuous clay layers intermixed with unconsolidated sediment could not be accomplished by any single or multiple geophysical surface sensor. Most often the only reliable alternatives for defining such complicated profiles were expensive and time consuming logging of closely spaced exploration wells, and down-hole geophysical detection.

Technology Description:

A prototype fusion workstation has been developed that processes multiple sensor data with sufficient fusion automation to be accessible to engineers with minimal training in data fusion technology. The software will be used for characterization of hazardous waste sites by delineation of contaminant plumes and by identification of thin clay layers and geological discontinuities up to a depth of 300 feet. Fusion methodology may have wide applicability to the numerous sites that have environmental management needs.

Fusion methodology has been applied to Time Domain Electromagnetics (TDEM) and seismic data with the goal of obtaining shallow, high-resolution subsurface images. It combines non-invasive geophysical sensors including TDEM and near surface seismic exploration techniques. A high frequency seismic source is used to identify thin strata, while algorithms will be developed for differential processing of TDEM which will result in a three-dimensional display.



The main elements of a fundamental data fusion system have TDEM and seismic data processed separately to provide inputs to sensor data fusion. Current TDEM subsurface images are obtained by an EM-inversion process that adjusts the image until it is consistent with the data. Fundamental sensor fusion adjusts the image until it is simultaneously consistent with data from all the sensors. EM inversion uses pre-processed data rather than raw data in the inversion steps leading to a geologic cross section. Fundamental sensor fusion uses the same pre-processed data as EM inversion and also uses pre-processed data from other sensors. In addition, sensor fusion may use geologic cross sections from individual sensors to initialize fusion processing. Geological site conditions and geophysical boundary conditions are also used in the fusion process.

The fundamental sensor fusion approach combines data from complimentary sensors with explicit geophysical understanding to form a subsurface image. Information contained in the data is directly combined with physical information to form the best image.

Benefits:

<3D subsurface images over a wide region outside that of known geological structure

<Evaluation of fusion methodology and seismic sources

<Accessible to people with minimal training in data fusion technology

<Wide applicability to sites with environmental management needs

<Usable offsite through computer terminal

Status and Accomplishments:

This project was completed in December 1995. Prior to project completion, the technology was demonstrated and deployed at the Department of Energy's (DOE's) Savannah River Site (SRS) in the A/M Area and the Old Burial Ground site. At completion, SRS purchased the software to continue to implement definition of deep subsurface strata and provide more cost effective rationale for future monitoring and remediation activities.

The technology was also deployed at the Hanford 200 West Carbon Tet Expedited Response Action site in 1995. Other DOE site applications include Fernald and Pantex (Texas).

This technology has also been used at multiple Department of Defense sites including U.S. Air Force sites in California and Massachusetts and Letterkenny Army Depot in Pennsylvania.

Contacts:

Phillip Gallman
Coleman Research Corporation
Phone: (703) 719-9200
E-mail: phil_gallman@mail.crc.com

Vijendra P. Kothari
National Energy Technology Laboratory
Phone: Phone: (304) 285-4579
E-mail: vijendra.kothari@netl.doe.gov

Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 290
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For additional information, please visit the Coleman Research Corporation website at http://www.crc.com/